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1. GENERAL DESCRIPTION

This is a revised version of the original DES-600 EPS-1. The title has been changed to reflect the broader scope of this controller. The DEC-6000 DATA ENTRY CONTROLLER (DEC-6000) is a combination of hardware and software which perform a wide range of document entry and communication functions for the 600/6000 systems user. Each document reader/sorter is treated in a dimension similar to a real-time device or terminal. This approach to document entry allows the user of GECOS-GERTS operating system.

The DEC-6000 controller shall consist of one Intercomputer Adapter, up to six Document Handler Channels, one Medium Speed Common Peripheral Adapter with Card Reader and a Console Adapter with a model 33 teletypewriter or TN300 as a control console. In addition the controller will support one High Speed Line Adapter with up to 32 communication lines. The control console may be connected to the HSLA.

The DEC-6000 Data Entry Controller shall provide the hardware interface for document handlers, MRS200, DRD200 and DRD236. The MRS200 and DRD200 document handlers shall be interfaced by a Common Peripheral Medium Speed Adapter with a document handler patch module. When this channel is used as a document handler channel, it is designated by the type number DHC600. The DRD236 is interfaced by a specially designed channel (DHC601) which will service this device only.

The DEC-6000 controller will support communication activity simultaneously with document entry processing. The communication lines will allow up to 32 subchannels. The specific number and mix will be determined by the document entry load.

The software in the Data Entry Controller shall provide the support for the above interfaces and control the operations of the document handlers. The controller shall also contain the generalized document entry program that performs data validation and pocket selection in accordance with parameters delivered by the control program in the 600/6000.

1.1 PURPOSE OF THIS DOCUMENT

This document defines the hardware and software requirements which must be met by the DEC-6000 Data Entry Controller in order to satisfy the objectives stated in Section 1.

1.2 SCOPE OF THIS DOCUMENT

This document describes, in general terms, all of the hardware which makes up the DEC-6000 Data Entry Controller. In addition, the software needed to make the hardware meet the objectives stated in Section 1 is described. This document is a system specification, and as such, is broad in scope. Details of hardware design and operation are not included in this specification, but shall be found in the Engineering Product Specifications for each of the hardware modules. A list of documents which specify or discuss the various parts of the DEC-6000 Data Entry Controller is included in Section 1.3.

1.3 APPLICABLE DOCUMENTS

General Design Requirements for 655/355, 43A177851

EPS-1: 355 Computer, 43A219608
EPS-1: GERTS/355, 43A219619
EPS-1: 355 Medium Speed Common Peripheral Adapter, 43A219614
EPS-1: 355 Console Adapter, 43A177852
EPS-1: DATANET-355, 43A219609
EPS-1: 655 I/O Multiplexer, 43A219604
PPS : Common Peripheral Interface, 43A130524
EPS-1: 355 Intercomputer Adapter, 43A219612
PDS : 625/635 Memory Controller, 43A143120
EPS-1: 655 System Controller, 43A219602
EPS-1: 355 Maintainability Design
EPS-1: DES-6000 Software, 43A177866
EPS-1: DHC-601 Document Handler Channel for DRD236, 43A232439
EPS-1: High Speed Line Adapter, 43A219606
Purchase Specification H-236, 59A203170

2. SYSTEM OBJECTIVES AND CONCEPTS

2.1 OPERATIONAL CONCEPT

As envisioned for this system, the user shall be able to trigger the initiation of an entry run via a request from a DEC control console. The user request will include directions as to which set of parameters (from a prestructured data base) is to guide the run. In response to this request, the H-600/6000 will retrieve the designated run parameters (User Entry Run Table) from the file system and transmit them to the controller. Run control will then reside in the controller until the run is completed or terminated by the user via the control console.

2.2 RELIABILITY

Reliability of both hardware and software must be emphasized in the design of the DEC-6000 Data Entry Controller. An unreliable subsystem will impact the customer's total accounting operation.

Goals for MTBF and MTTR are specified in paragraph 6.1.2 and 6.2.1, respectively.

2.3 ERROR DETECTION AND RECOVERY

The DEC-6000 Data Entry Controller shall have sufficient error detection and recovery capability so that the operator is not unnecessarily burdened with the problem. Reconfiguring the system by bypass a malfunctioning hardware component, where possible, must be easy and fast with emphasis placed on minimizing the number of document handlers affected by a particular error.

Recovery procedures shall be built into each device handling routine for independent control. They should include the capability to re-initiate a device that has gone "not ready" for any reason. Normally, the document handlers will go "not ready" for the following conditions:

1. Hopper empty
2. Full Stacker Pocket
3. Stopped Transport

4. Feed Failure
5. Jam Detection
6. Mis-sort Detection
7. Depression of Start/Stop Bar
8. Open Interlock (DRD236)

A jam or mis-sort at the sorter will terminate all input from the device. This type of condition will require only that the routine is in standby, waiting for resumption. It must, of course, be an independent action for only the device involved.

An internal timing problem may cause overrun of buffering areas. The recovery routine should be able to degrade the system incrementally to respond to the overflow condition. One sorter at a time would be shut down (stop feed) until the buffers have been emptied to a safe operating level.

Hardware shall be provided to detect malfunctions. When problems are detected by this automatic hardware checking, information about the error condition will be passed on to the software, which may be able to effect recovery or identify the error for later resolution. An error, while reading a document, cannot be retried, but an error record shall be made and the document rejected. The software shall give special notification if the quantity of errors or the error rate exceed preset limits.

2.4 NUMBER OF CONCURRENT DOCUMENT HANDLERS

The DEC-6000 Data Entry Controller shall have as a design goal document handlers of at least six documents, in any mix of handlers specified in paragraph 1.0, running concurrently. When also servicing communication lines at least four document handlers (any mix) with 12 TTY grade lines and two voice grade lines should run currently.

2.5 I/O RATES

The DEC-6000 Data Entry Controller must be able to transfer data concurrently from all document handlers and communication, as specified in Section 2.4 plus be able to transfer a similar amount of data to the H-600/6000 through the Intercomputer Adapter at the maximum rate for each of the document handlers and communication lines without comprising its ability to provide satisfactory response to program interrupts. The DEC-6000 must also concurrently support as many control consoles as there are document handlers with the messages necessary to maintain an effective interface between the document handler operator and the DES-600 Document Control Program. Document listing will be available via the 600/6000 System Line Printers for reconciliation.

3. HARDWARE IMPLEMENTATION

The DEC-6000 Data Entry Controller shall consist of:

	Minimum	Maximum
DEC with 16K Memory	1	1
Additional 16K Memory	1	1
Intercomputer Adapter	1	1
Common Peripheral Adapter and Card Reader	1	1
Console Adapter and TTY	1	6
Document Handler Adapter and Document Handler	1	6
High Speed Line Adapter	0	1

3.1 HARDWARE ORGANIZATION

Figure 3.1.1 is a block diagram of a H-600/6000 System with four system controllers and a DEC-6000 Data Entry Controller. Although only one processor is shown in Figure 3.1.1, it is not the intent of this specification to limit the system to a single processor. Multiple processors can be used in conjunction with suitable software. The four memory controllers shown in Figure 3.1.1 are the maximum quantity that can be included in a single H-600/6000 System. Most actual systems have fewer than four memory controllers.

Figure 3.1.2 is a block diagram of the DEC-6000 Data Entry Controller showing one DEC, one Intercomputer Adapter, one Console Adapter and TTY, one Common Peripheral Adapter with Card Reader, one Common Peripheral Adapter (with Document Handler Option) (DHC600) with a MRS200 Document Handler, one DHC601 Document Handler Channel with a DRD236 Document Handler, and one High Speed Line Adapter.

The DEC-6000 Data Entry Controller must provide at least one I/O Teletypewriter to be used as a control console. It shall be possible to provide multiple consoles, up to one per handler device. In addition, the High Speed Line Adapter will service remote TTY's as well.

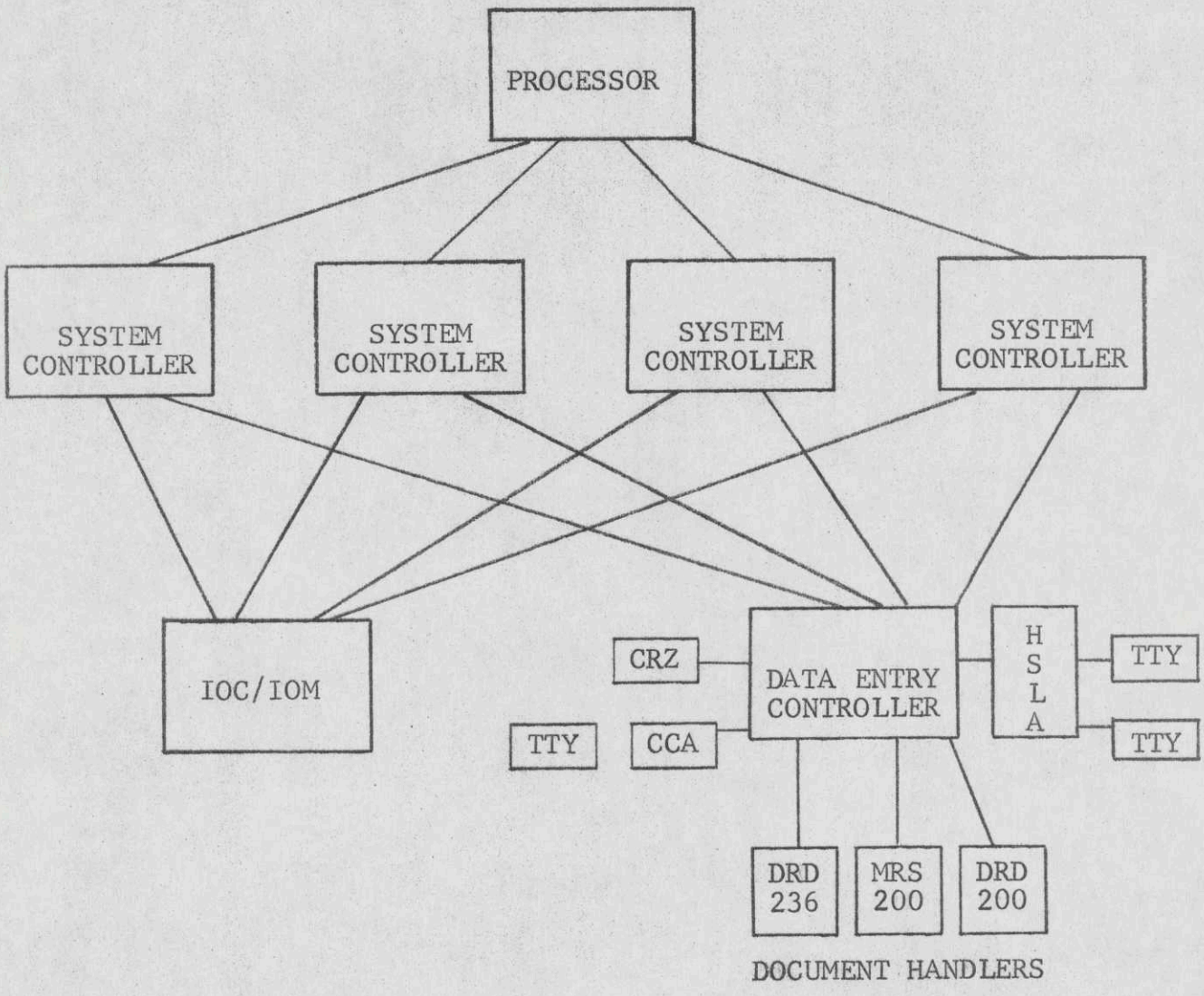
PROCESSOR
SYSTEM CONTROLLER
SYSTEM CONTROLLER
SYSTEM CONTROLLER
SYSTEM CONTROLLER
IOC/IOM
CRZ
DATA ENTRY CONTROLLER
H S L A
TTY
TTY
TTY
CCA
DRD 236
MRS 200
DRD 200
DOCUMENT HANDLERS

Figure 3.1.1

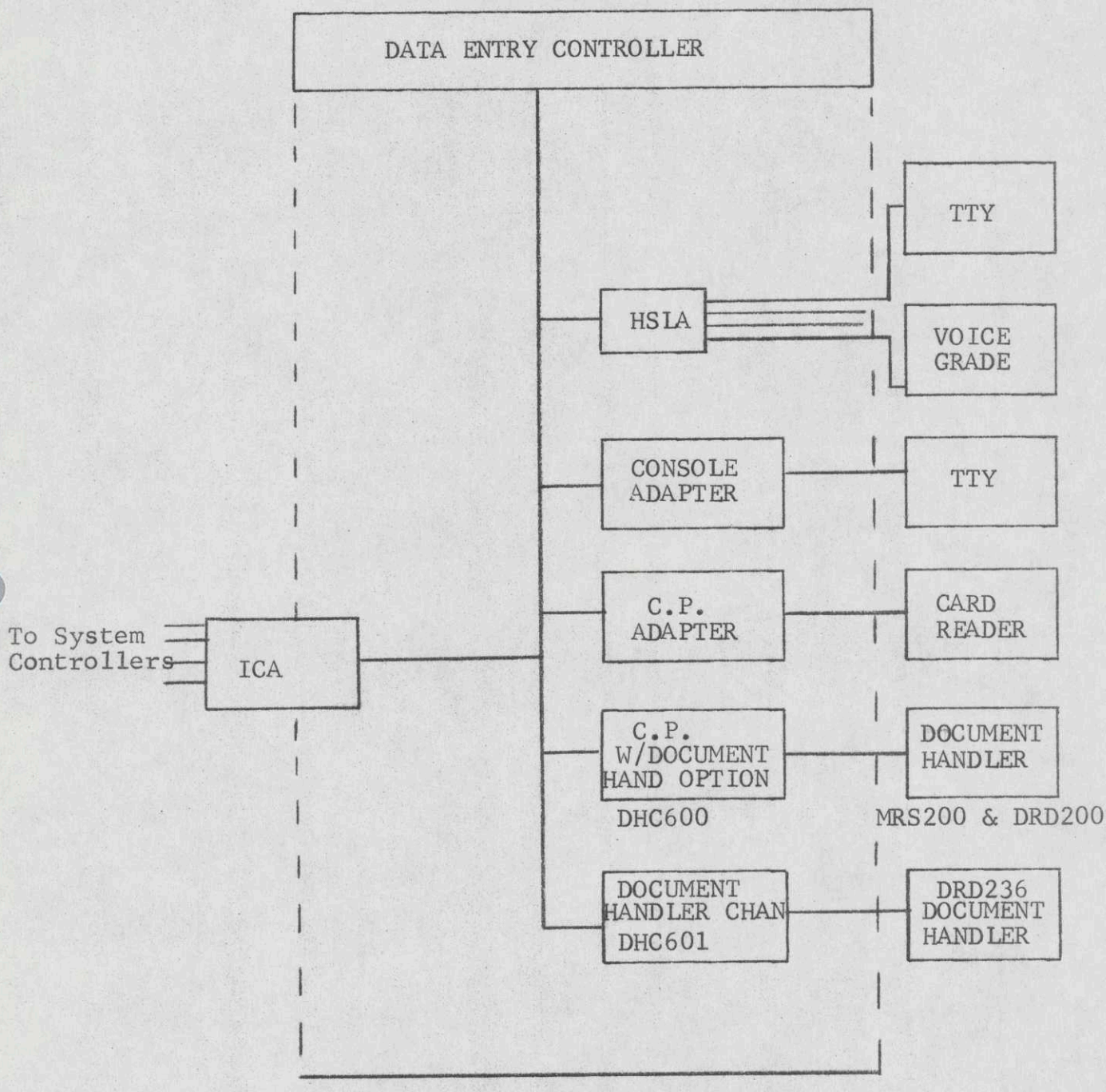

Figure 3.1.2 - DEC-6000 Data Entry Controller

3.2 HARDWARE INTERFACES

3.2.1 H-600/6000 System Interfaces

The Intercomputer Adapter of the DEC-6000 Data Entry Controller may be connected to a H-600/6000 System through any one of two types of interfaces:

- GE-635 System Controller ports (maximum of four can be used concurrently)
- H-6000 System Controller ports (maximum of four can be used concurrently)

3.2.2 Document Handler Interface

The Medium Speed Common Peripheral Adapter (with Document Handler Option) shall connect the MRS200, and the DRD200 document handlers to the controller. Refer to Section 1.3 of this specification for a list of the applicable technical specifications for these document handlers and the Medium Speed Common Peripheral Adapter. The DRD236 document handler will be connected to the system through the DHC601 document handler channel - see EPS-1 43A232439 for detailed description.

3.3 HARDWARE MODULES

3.3.1 Data Entry Controller

The DEC is a small, general purpose, stored-program digital computer of microelectronic construction. The processor is a parallel, binary fixed-point computer that utilizes a random access store with a cycle time of one microsecond or fater. Data of variable word lengths --6, 9, 18 or 36 bits - may be freely intermixed and fully packed in the store. All data word lengths are individually addressable to allow highly efficient processing of tabular data.

Ninety-nine instructions in an 18-bit format are provided, with one single-address instruction per word. Three index registers and multilevel indirect addressing with indexing at all levels allow addressing of up to 32, 768 18-bit words.

The input/output is designed to facilitate efficient real-time concurrent servicing of multiple peripherals and external devices. Up to 16 channels can be provided to accommodate a total data transfer rate of up to approximately 450,000 words per second (with 6, 9, 18 or 36 bits per word) independently of processor operations. Sixteen levels of priority interrupt, with 16 sublevels per level and with corresponding interrupt level masks, are provided.

The DEC instructions are symbolically similar to the 600/6000 instructions and provide characteristics functionally identical to the most commonly used 600/6000 instructions. The 99 machine instructions of this computer provide operations normally found only in large-scale processors. Instructions for arithmetic and Boolean operations, shifting, comparison, data movement, and peripheral equipment control are included.

The organization of the Data Entry Controller is logically similar to that of a 600/6000 System. The DEC is a store-oriented computer with independent store, processor and input/output modules. These three basic modules are independently timed, and they operate asynchronously to each other. The processor and the input/output multiplexer (which are active units) process data at their own rates and request cycles from the store module (a passive unit) as the need arises. The only knowledge one active unit has of the other is that a cycle request to the store may be delayed while the store is responding to the other active unit. Only when the processor executes certain input/output instructions must the processor and the input/output multiplexer communicate with each other.

3.3.2 Intercomputer Adapter

The Intercomputer Adapter (ICA) provides a link between the DEC's input/output bus and up to four ports on the 600/6000 line computer. The ICA transfers control information and data between the two machines in the normal system environment. In normal data transfer activities, the ICA acts as an agent of the controller which controls all detailed transactions. In addition,

the 600/6000 exercises control over the ICA and can initiate a bootload into the controller or program interrupt the DEC. The basic ICA operation is direct by 36-bit word into both the DEC and the 600/6000. The transfer rate of the ICA is artificially limited by design, so that the ICA cannot hog access to the 600/6000 store from the Data Entry Controller.

3.3.3 Common Peripheral Adapters

The 355 Common Peripheral Adapters connect standard common peripheral subsystems to the DEC I/O bus. The Medium Speed Common Peripheral Adapter uses the bus to transfer each 6-bit character.

The Medium Speed Common Peripheral Adapter (DHC600) with the document handler option shall interface the MRS200 and DRD200 document handler to the DEC I/O bus. This interface is similar to the Common Peripheral Interface plus allows commands while busy and includes one additional status line.

3.3.4 Card Reader

The common peripheral card reader shall be included with each DES600 Document Entry Subsystem so that a means will exist for bootloading the DES600 Document Entry Subsystem for test and diagnostic purposes when it is not possible for the 600/6000 to initiate the bootload through ICA. The card reader may be a 900 CPM device (CRZ201) shared with the 600/6000 system through a manual peripheral switch, or it may be a 300 CPM device (CRZ100).

3.3.5 Console Adapter

The 355 Console Adapter connects a teletypewriter to the DEC I/O bus so that it can transfer one 8-bit character of data at a time.

A model 33 or 35 Teletypewriter will be connected to the CCA so that a means will exist for supplying messages to the operator, programmer, or field engineer so that they can control the operation of the DEC 6000 controller when it is in the GERTS or T&D environment.

3.3.6 High Speed Line Adapter

Communication capability will be allowed on the DEC 6000 Controller through a high speed line adapter. No low speed line adapter will be supported. Up to 32 lines of TTY and voice grade terminals will be allowed. The actual number of lines and mix to be determined by the document handler loading and the type of terminals to be serviced. The design goal is to service four document handlers with at least two voice grade lines and 12 TTY lines.

At least one model 33 Teletypewriter shall be included with each DEC 600/6000 Data Entry Controller so that a means will exist for supplying messages to the operator or field engineer can control the operation of one or more document handlers.

3.3.7 Document Handler Devices

The MRS200 document handlers shall connect to the DEC-600 Data Entry Controller through a Medium Speed Common Peripheral Adapter with Document Handler Option (DHC600). These document handlers read MICR. The DRD200 Document Handler shall also connect to the subsystem through the Medium Speed Common Peripheral Adapter with Document Handler Option (DHC600). This document handler reads the COC-5 character documents and, optionally, mark sense documents. The DRD236 Document Handler shall be connected to the DEC6000 controller through its own document handler channel (DHC601). This channel does not have a common peripheral interface, instead it interfaces the Burrough's document handler on one side and the DN355 IOM bus in the other. This channel is designed exclusively for the DRD236 and no other peripheral device may be connected to it.

3.4 INITIALIZE AND BOOTLOAD

There shall be provisions for initializing and bootloading the DEC-6000 Data Entry Controller from either of the two following sources:

- Issuance of a bootload instruction to the ICA by the 600/6000.

- Bootload from the card reader. The boot is initiated from the bootload pushbutton on the DEC Maintenance Panel. This action causes initialization of the DEC processor, and the DEC IOM executes a hardwired program built into the IOM to read in one card. This first card contains a program which continues the bootload operation.

4. SOFTWARE IMPLEMENTATION

The software for the DEC-6000 Data Entry Controller is a small portion of an overall Banking Software Package and communications. This specification will concern itself only with that portion of the system required to capture the basic information on the document and produce a computer readable record (tape or disk). This portion of the overall Banking System will be called the Document Entry Software for DEC-6000 Data Entry Controller. (Refer to DES-6000 Subsystem Software Specification 43A for detailed operational software description.) Besides the operational software, support software packages and Test and Diagnostic Software packages are available for the DEC-6000.

4.1 OPERATIONAL SOFTWARE

Figure 4.1 is a block diagram of the software for DEC-6000 Data Controller Entry required to capture and verify the information contained in a document and generate a permanent record in the entry data file.

The individual components of software are discussed below.

4.1.1 Pocket Select Table Generator

The Pocket Select Table Generator will be a utility type program that will allow easy generation, modification and display of the Pocket Select Tables by the 600/6000 System. The input to this program shall be card from a Direct Access Terminal, or 600/6000 System.

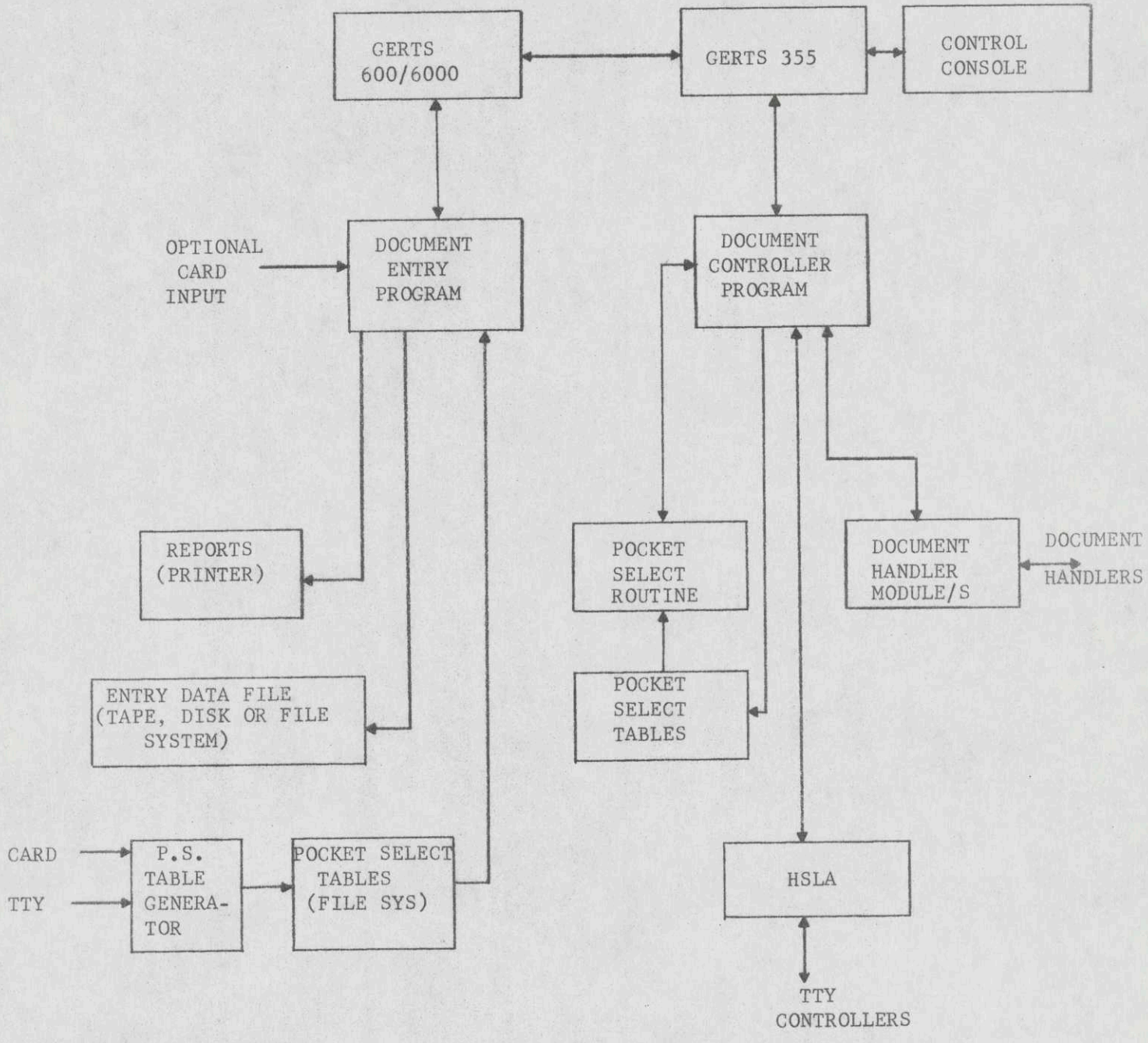
GERTS 600/6000
GERTS 355
CONTROL CONSOLE
OPTIONAL CARD INPUT
DOCUMENT ENTRY PROGRAM
DOCUMENT CONTROLLER PROGRAM
REPORTS (PRINTER)
POCKET SELECT ROUTINE
DOCUMENT HANDLER MODULE/S
DOCUMENT HANDLERS
ENTRY DATA FILE (TAPE, DISK OR FILE SYSTEM)
POCKET SELECT TABLES
CARD
TTY
P.S. TABLE GENERA-TOR
POCKET SELECT TABLES (FILE SYS)
HSLA
TTY CONTROLLERS

Figure 4.1

4.1.2 Pocket Select Tables

The Pocket Select Tables are stored in the 600/6000 File System and contain the parameters to control the Generalized Pocket Select Routine in the DEC. Several versions of the Pocket Select Tables will be stored in a relocatable form for use in the DEC, as needed.

4.1.3 (600) Document Entry Program

The 600 Document Entry Program shall be the heart of the Data Entry Controller Subsystem. All actions shall be initiated from this program. This program shall be a slave program under GECOS.

The 600 Document Entry Program shall provide the following functions:

- Process request from the Document Control Consoles connected to the DEC.
- Authorize the starting and stopping (except in emergencies) of the document handlers.
- Obtain the required Pocket Select Tables from the 600 File System, perform any necessary relocation and send the Pocket Select Tables to the Data Entry Controller.
- Request the bootload of the DEC when an unrecoverable situation occurs. The 600 Document Entry Program will restructure tables after the bootload.
- Maintain tables of the configuration and apparent status of the DEC.
- Generate the Entry Data File in a standard system format from data received for the Document Entry Controller.
- Prepare the Reconciliation Reports required to maintain an audit trail on all documents.

The 600 Document Entry Program shall have restart recovery capability which will permit recovery without restarting the job in the event the DEC fails. In the event the 600/6000 fails, restart shall be consistent with GECOS recovery procedures.

4.1.4 Data Entry Controller Program

The Data Entry Controller Program shall use the hard core of GERTS/355 (see Section 1.3) as the hard core of this program.

The Data Entry Controller Program shall provide the following functions under the direction of the 600 Document Entry Program.

- Control all resource utilization in the DEC, including processor time and core allocation.
- Interface with the 600/6000 through the Intercomputer Adapter.
- Control the logical relationship of consoles, document handlers and pocket selection tables.
- Interface the instructions and messages from the 600/6000 with the appropriate interface modules.

4.1.5 Document Handler Module

The Document Handler Module shall provide the required functions to service the physical interface with the MRS200, 236 and the DRD200 document handlers. This module will issue the connect instructions to start I/O action with Document Handler Devices and process the interrupts resulting from the completion of each I/O action. This module shall have preset information so that the instructions needed to maintain the continuous feed and read mode of the document handlers without requiring interface with another program. The document handler module shall interpret the status and take the necessary corrective actions. Uncorrectable errors shall be reported to the 600/6000. Statistics shall be maintained on any error conditions correctable or uncorrectable with thresholds that shall cause an orderly halt if they are exceeded. This action shall be reported to the 600/6000 Control Program for action.

4.1.6 Console Module

The console module shall provide the required functions to service the physical interface with a teletypewriter on the control console adapter. Input messages shall be sent to the 600/6000 Document Entry Program for interpretation and output messages shall be received from the 600/6000 Document Entry Program.

4.1.7 Generalized Pocket Select Routine

The Generalized Pocket Select Routine shall make the pocket decision on each document in real time. This routine shall be table driven and shall be capable of handling several document handlers and multiple Pocket Select Tables. The Generalized Pocket Select Routine shall have the logic to link multiple document handlers to one Pocket Select Table and shall be able to change this linkage dynamically on a halted document handler under direction of the 600/6000 Document Entry Program.

The Generalized Pocket Select Routine shall provide the following functions:

- The input data shall be validated. The specific fields to be validated will be defined in the Pocket Select Table.
- The Transposition Check Digit will be valid if required using one of the preprogrammed algorithms.
- The Pocket Decision will be made based on the field specified in the Pocket Select Table.
- The output buffer will be formatted. The format and any constant portion of the resulting records will be controlled by the Pocket Select Table.

4.2 SUPPORTING SOFTWARE

4.2.1 Assembler

The 355 Assembler (355 MAP) is a program that executes on the 600/6000 and operates under GECOS, using the generalized input/output services of the general file and record control (GEFRC). The assembler accepts as input symbolic 355 machine

language instructions and produces relocatable or absolute binary card images on the program output device. A list of the symbolic program and its assembled equivalent is produced on the list output device.

4.2.2 355 Simulator

The 355 Simulator is a program that executes on a 600/6000 processor. The program operates under GECOS, and uses the generalized input/output services of GEFRC. The simulator simulates all instructions of the 355 except those which pertain to input/output. A set of special input/output instructions are provided to allow for simulation of I/O instructions.

4.3 TEST AND DIAGNOSTIC SOFTWARE

Test and Diagnostic programs shall be available for testing the DEC600 Data Entry Controller in the following modes:

- Communication On-Line Test System (COLTS)
- Partial On-Line OPTS/MONITOR-355
- Off-Line MONITOR-355

4.3.1 Total On-Line Operation

In this mode of operation, both the 600/6000 System and the DES-600 Subsystem are on-line and available to the user system. The particular device will be deallocated by the operating system software (refer to paragraph 6.3.1). Entry into this mode shall be by operator input via the DEC-600 Teletypewriter local and remote console. Normally, this occurs as a result of a malfunction or malfunction suspected report by the DEC-600 Subsystem software.

This capability, however, is also expected to find use during periods of slack operation for routine PM.

4.3.2 Partial On-Line Operation

In this mode of operation the 600/6000 System is on line and available to the user while the H-600/6000 Controller is off-line. None of the document reader devices is available to the user while operating in this mode.

Operator communication, as in paragraph 4.3.1, is via the DES-600 Teletypewriter.

4.3.3 Off-Line DEC-6000

In this mode of operation the 600/6000 is not available for the DEC-6000 testing. This means that the full control program functions must reside in the DEC-6000 Controller. PAS-355 is available for controller mainframe, store and IOM testing. (Refer to 355 Maintainability Specification for 355 Processor, Store and IOM T&D Software Specification.) MONITOR-355 is available for peripheral and communications equipment T&D.

Input to the stand-alone system shall be by card reader. Output and operator communication is via the teletypewriter.

5. GENERAL DESIGN REQUIREMENTS

Whenever possible, subsystem design shall conform to available group standards. Any deviations must be approved by the Systems Department responsible for this specification.

The following Group Standards are available at this time:

B01.08	Environment
B01.09	General Product Safety
B01.10	Equipment Handling Transportation and Storage Criteria
B01.47	UL Listing, UL 478 "Standards for Safety Electronic Data Processing Units and Systems"
B01.48	Primary Power
B01.49	Glossary, General Design Standards
B04.06	Grounding

5.1 DEVICE

The design requirements of the DRD200, DRD236 and MRS200 are contained in their respective performance specifications.

5.2 CONTROLLER

With the exception of the card, document and TTY devices, the subsystem shall be implemented using MQX/355 integrated circuit boards and chips wherever possible.

The logic shall be organized in a manner designed to aid in isolating failures to a circuit board. The circuit boards shall conform to MQX/355 PWB standards in order to permit chip failure isolation by the MQX board tester. The controller shall be designed to conform to 43A177851, General Design Requirements for 655/355 Systems.

6. RELIABILITY AND MAINTAINABILITY

6.1 RELIABILITY

6.1.1 Availability

The subsystem availability objective will be a minimum of 99 percent, where:

$$\text{AVAILABILITY} = \sum(100)(\text{MTBF})/(\text{MTBF} + \text{MTTR})$$

6.1.2 Mean Time Before Failure

Failures which occur within the subsystem can be classified as subsystem failures, and single document handler failures. A subsystem failure is a failure which affects all handlers connected to the subsystem. A single document handler failure is a failure which affects only one document handler connected to the subsystem.

As a result of these definitions a failure is classified as a subsystem failure if it occurs in the ICA or in the DEC (processor, store, IOM).

The minimum acceptable MTBF for subsystem failures excluding the document handlers shall be 1600 hours.

The minimum acceptable MTBF for a failure in a subsystem, including a single MRS200 document handler shall be 150 hours.

6.1.3 Transient Error Rate

The transient error rate shall not exceed one error in 10^{13} bits transferred excluding the document handlers.

6.2 MAINTAINABILITY TARGET GOALS

The target goals for subsystem maintainability are summarized in the following paragraphs. Refer to 355 Maintainability Design Specification for Comprehensiveness of T&D Programs for the 355.

6.2.1 Mean Time to Repair

An average system down time of not more than 45 minutes shall be the goal for detection, diagnosis, subsystem repair, and subsystem repair verification of any single hard failure anywhere in the logic circuitry of the subsystem. Refer to 355 Maintainability Specification for Predicted Growth of MTTR Improvement toward Target Goals.

Subsystem repair may be accomplished by replacing a failed module or assembly from on-site spares. The failed module or assembly can then be repaired and verified when convenient.

Subsystem repair verification means that the subsystem repair is shown to permit successful completion of those tests which are known to have failed before the repair; it does not mean requalification, which implies exhaustive running of the full repertoire of tests and reruns of customer programs which were unsuccessful because of the failure.

Other assemblies (such as power supplies, maintenance panels, peripheral devices,etc.) shall conform to this criterion insofar as their logic circuitry is concerned but are exempted if they experience a physical, mechanical or major electrical failure.

It is assumed that maintenance personnel are immediately available upon detection of a failure. If they are not, time will not be counted between failure detection and arrival of maintenance personnel.

6.2.2 MQX Board Tester

The new components of the DES-600 Document Entry Subsystem shall be designed to make efficient use of the MQX Board Tester for fault isolation. This shall include the bringing of test points to a connector to diagnose complex logic and to adhere to interface standard of the board tester.

6.3 MAINTAINABILITY

The maintainability requirements of this section assume the performance of repair and specified preventative maintenance activities by trained and experienced personnel.

The maintainability requirements also assume that on-line maintenance procedures will be used whenever possible to diagnose, replace or adjust faulty components.

The maintainability requirements further assume the use of software recovery and restart (R&R) techniques. (Refer to paragraoh 6.3.2.)

6.3.1 Device Allocation for T&D

During execution of the total on-line or partial on-line test and diagnostics, it is necessary to protect the user from the undesirable results of using malfunctioning components. Thus, there need be capabilities of reserving devices and/or channels to maintenance functions, and excluding all other users from their use.

When a device is known to be malfunctioning, it is necessary that the 600/6000 System deallocate the device and inform the operator of this fact.

6.3.2 On-Line Recovery Procedure

The Document Entry Subsystem shall provide restart and on-line T&D to enable recovery from a variety of error situations. Specifically, the subsystem shall insure recovery via checkpoints, control totals, etc., from failure of the document handler or handlers; Document Entry Controller or 600/6000 System.

The error rate for each document handler shall be monitored by the 600/6000 control program. When a predetermined threshold for a document handler is reached, a restart point will be established, the handler stopped and a message outputted via the console or handler TTY. The reason for stopping the handler will be given. The operator will then be given the option to call in T&D or resume normal processing on the questionable handler.

In addition, the operator shall have the option, at any time, to request T&D for a given handler. When so requested, the 600/6000 control program will stop the appropriate handler, insure a restart point for resuming operation and signal the operator that T&D is in control of the handler. Whenever T&D is in charge, the handler will be deallocated from the Document Entry Subsystem (refer to paragraph 6.3.1). Once a document handler or handlers are deallocated from the production environment, the 600/6000 control program may call in the T&D Subsystem to perform diagnostics on the malfunctioning subsystem until a message is received via the TTY or console typewriter to return the handler to production status. At this time, the operator will be notified to resume processing from the last control point, checkpoint, etc.

6.4 MAINTENANCE PLAN

When a subsystem interruption, or component failure, does occur there must be a plan -- already formulated in general terms -- which can be rapidly put into operation in order to affect early diagnosis.

The main objective is to keep the data available to the system and perform diagnosis with minimum disturbance of the system. This places the emphasis on on-line diagnosis routines rather than off-line T&D.

If the status returns indicate the strong possibility of malfunction, then entry into the performulated maintenance plan is indicated. In general, COLTS will be the first test and

diagnosis aid which will be used once a malfunction in the subsystem is suspected. There is a possibility of identifying a device problem even before calling COLTS. This immediate isolation could result through the receipt of device status conditions, for example. In other cases the malfunction may be isolated to the device level only after running some on-line diagnostic routines.

Through the use of COLTS the important decision of whether or not to remove the entire controller from service is made. When only one document handler is on the subsystem, this decision is of academic interest only. When more than one device is being used, the decision to remove the controller from service means a halt to document processing.

As stated above, the primary function of COLTS is to identify the malfunctioning module to the device, controller mainframe, or controller adapter level. Depending upon this identification, the next step in the maintenance plan will be the controller on-line diagnostics, the 355 Off-Line T&D software or manual device operation.

The main objective is to keep the data available to the system and perform diagnosis in such manner that the least effect is felt by the system.

The 355 Off-Line T&D programs, since their use requires that the controller be off-line, should be used only when on-line diagnosis fails. The 355 off-line test and diagnostic programs directed to the controller, ICA and adapters, as well as those routines directed at the devices, should find use during scheduled PM periods when the subsystem is off-line.

From the on-line diagnostics the next step toward the isolation of device malfunctions is the device itself. An operator's panel is available for controlling the device in the off-line mode. Operator panel indicators and a small maintenance panel are used in effecting the device repair.

If the problem is in the computer-controller mainframe, it may be necessary to bring the subsystem down and load the controller memory with the 355 Off-Line T&D programs necessary to diagnose

and isolate a mainframe malfunction. Such Test and Diagnostic programs are required to locate the problem to the circuit board level.

Once the problem is located to the board level, the MQX Board Tester is used to repair boards (off-line) from the controller mainframe, the ICA, and the adapters.

6.4.1 COLTS-6000

The Communication On-Line Test System (COLTS) is a subsystem of the 6000 Line Total On-Line Tests (TOLTS-6000). Its function is to provide on-line testing of communication and document handler equipment connected to the DEC-6000 Data Entry Controller.

The on-line capability of COLTS means that production work on nonfailed document handlers can continue during troubleshooting of a suspected document handler device. This on-line capability also provides the capability to test the subsystem during slack periods of customer operation. This allows the normal scheduled PM time to be utilized more effectively in the actual maintenance of equipment, rather than the running of tests and minimum repair time for unscheduled maintenance.

Document handler testing through COLTS will be driven in much the same manner as the DEC Document Control Program, using "MME GEROUT'S" to initiate T&D action in the 355.

To enhance the diagnostic capabilities of T&D in the on-line environment the DEC-6000 Control Program and the Document Entry Control Program must be sensitive to special needs by COLTS. For example, T&D must be allowed to supply Pocket Select Tables for a handler under test, T&D should also be allowed to issue nonstandard or illegal command sequences to the devices.

Through cooperation of the Document Entry Control Module and special T&D functions in the controller, all hardware statuses, nonedited data patterns and software statuses will be transmitted to the 600/6000 for functional diagnosis. The COLTS Document Handler Test Program will analyze the data and provide error messages and operating instructions to the maintenance operator.

In the event that diagnostics are impossible within the production environment, the Document Entry Subsystem shall accept a shutdown request. This will result in the establishment of checkpoints or restart points for all document handlers in the subsystem, termination of the 600/6000 Control Program and turn the DES-600 Subsystem over to the partial on-line or total off-line T&D system.

The objective of COLTS-DES is to provide a maintenance tool that will enable the prediction of subsystem failures before they become catastrophic isolate malfunctions to the lowest possible level and if necessary direct the maintenance personnel to the next level of diagnostics.

6.4.2 OPTS/MONITOR-355

OPTS/MONITOR-355 is the partial on-line T&D system. In this system the 600/6000 is on-line (operating in a production environment under GECOS) and the DES-600 subsystem is off-line. This system is similar to the total on-line system since it has use of the on-line 600/6000. In this system it would be possible to broaden T&D software resident in the DES-600 controller since the operational document entry modules may not be needed.

The opportunity for use of this T&D system would normally exist when a DES-600 Subsystem is being brought up for operation with an on-line 600/6000. The system, however, may find additional T&D use as a partial on-line system because of freedom from 355 core limitations.

6.4.3 MONITOR-355

T&D procedures in this T&D mode of operation (total off-line) must be different from the other two. The power of the 600/6000 is not available for T&D.

The programs are fed into the freestanding controller via the card reader.

All communication between the operator/maintenance man continues to be via DES-6000 console.

6.5 BOARD TESTER

The board tester is a freestanding self-contained unit which is functionally composed of a card reader, tester logic, display panel, power supply, test library, and a fault dictionary. Although not a physical entity of the board tester, the Automatic Test Vector Generator (ATVG) and Fault Analysis Simulation (FAS) programs are integral to the support of the board tester.

A unique test deck is associated with each 355/655 board type, model and/or revision status. The first cards of the test deck are configuration cards which are utilized by the tester logic to set up the configuration logic for each pin of the board under test. The subsequent cards of the test deck (the test cards) contain the test information for each sequence.

The objective of the board tester is to provide an effective means of performing semi-automated status tests on all 355/655 integrated circuit boards. Test criterion is the capability of isolating malfunctions with an average resolution of 2.5 integrated circuit modules (IC's) and a maximum of 10 IC's per board with a cumulative probability of 95 percent.

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